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POSITION DOCUMENT ON CHLORDANE

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1. CHLORDANE IS A CENTRAL NERVOUS SYSTEM AND LIVER TOXICANT

The National Academy of Sciences (NAS) noted that acute exposure to chlordane can cause headaches, nausea, dizziness, slight involuntary muscular movement, tremors, sweating, and general malaise (NAS, 1982). Furthermore, numerous reports exist in the literature of the neurotoxic effects of chlordane after acute exposure (Aldrich & Holmes, 1969; Hayes, 1982; Barnes, 1967; Olanoft et al, 1983). Two-year feeding studies in rats and dogs demonstrated the chronic effects of chlordane on the liver (Ingle, 1952, and FAO/WHO, 1963). The emergency ban in New York was based on chlordane's "...demonstrated ability to attack the central nervous system and (its) hepatoxicity" in addition to its persistence (NY Department of Health, February 20, 1985).

The New York Department of Health (NY DOH), in their risk assessment, reviewed the air guideline recommended by the NAS. NAS had recommended an interim guideline of 5 ug/m3. New York suggested that a guideline for non-carcinogenic effects could be based on two animal studies, with liver effects as the endpoint, and the FAO/WHO acceptable daily intake of 1 ug/kg/day. New York concluded "Based on non-carcinogenic toxicity, possible guidelines for chlordane in air range from 0.24 to 1.6 ug/m3 for a child and 0.53 to 3.5 ug/m3 for an adult" (NY DOH, 1984, pg.14). The New York Department of Health did not, however, adopt this or any other guideline.

2. CHLORDANE IS A CARCINOGEN

As we stated two years ago, it has been unequivocally determined by a number of independent and experienced individual reviewers and select committees that chlordane is a carcinogen (NCI, 1977; Epstein, 1976; IARC, 1979; CAG, 1977). It has produced liver neoplasms in 2 mice strains and, according to the International Agency for Research on Cancer (IARC), shows inconclusive results in rats (IARC, 1979).

Some have contended that chlordane is a "promoter", that is, that it does not directly act on the genetic material of the cell. They feel, therefore, that chlordane, as well as other promoters, should be treated differently since they believe a threshold exists for these chemicals, below which no cancer risk exists. As noted below, however, there is some evidence that chlordane may alter the genetic material of the cell. In addition, an impressive body of scientific opinion does not agree that such a sharp distinction can be made between promoters and initiators (substances acting directly on the genetic material)(NTP, 1984; OSTP, 1985; OSHA, 1980; Weinstein, 1983). Further, there is no scientific basis for estimating a threshold, i.e, "safe" level, for carcinogenesis. Typical comments on this issue include the following:

> "At present, given the lack of information on mechanisms of carcinogenesis in humans and the myriad interactions of tissue and the biological effects of promoters demonstrated in experimental systems, it is

> premature to designate agents as acting through only a promotion-type mechanism although a number of agents seem to have some promoter action" (OSTP, pg. 10390).

> "Although it has been stated that promoters have a threshold, there is little good evidence for this. Studies of the dose-response curves for promoters have clearly been inadequate for the purpose of defining a threshold..." (OSTP, pg. 10392).

> "...OSHA concludes that it would not be practicable or justifiable to establish different criteria for the identification, classification, or regulation of initiating and promoting agents. OSHA agrees with the NCAB (National Cancer Advisory Board) Subcommittee that "any factor or combination of factors which increases the risk of cancer in humans is of concern regardless of its mechanism of action" (OSHA, pg. 5152).

> " ... It is still not known whether some agents are only epigenetic (promoters) or only genotoxic (initiators). Even if there is a distinction, it cannot be assessed whether or not an agent is likely to be genotoxic in humans...There is no evidence that clearly establishes a threshold for promoters...known tumor promoters require repeat application whereas certain initiators require only one application. In many environmental carcinogens, this is precisely what is happening, as with air, water, and food carcinogens. Thus, there is repeated exposure over a long period of time. Furthermore, many carcinogens are persistent in the environment, and some even bioaccumulate" (Weinstein, 1983).

> " Recent progress in the understanding at the cellular and molecular level of multistage carcinogenesis would, however, suggest that such classification of carcinogens into different categories with the almost automatic implication of different degrees of risk for humans is still premature...As our knowledge of carcinogenesis advances, it is likely that we will find fewer arguments to support the sharp distinction that is now made between initiating and promoting agents" (NTP, pg.171).

While epidemiological studies have not shown conclusive evidence of human carcinogenicity, the existing studies are insufficient to prove, due to lack of sufficient follow-up time, for example, that chlordane is not a human carcinogen. A number of epidemiological studies have been conducted in occupationally exposed groups, such as pesticide applicators and manufacturers. In a study by Shindell et al, a statistically significant increasing trend for SMRs* for cancer deaths occurred with increasing length of employment. The NAS wrote "...the suggestion of a trend in cancer deaths with duration of employment indicates that more complete data are needed before firm conclusions can be reached with regard to the carcinogenicity of chlordane in humans" (NAS, 1982, pg. 19). The New York Department of Health agreed in its risk assessment of chlordane (NY, DOH, 1984).

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* SMRs = Standardized Mortality Ratio, equal to the number of observed deaths divided by the number of expected deaths times 100. An SMR greater than 100, therefore, means more deaths were observed than expected.

New York performed a quantitative assessment of the risk of cancer given a lifetime exposure to chlordane. The range was from 5 in 10,000 to 6.6 in 1000 given a lifetime exposure of 5 ug/m3 chlordane (NY DOH, 1984, pg.15). Further, the air concentration associated with an excess cancer risk of one in a million is approximately 0.001 ug/m3. The risk posed by the 5 ug level is clearly greater than the one in a million or one in a hundred thousand risk levels usually suggested for regulatory purposes.

3. CHLORDANE MAY BE MUTAGENIC

Mutagenicity results have been conflicting for chlordane. In the Ames assay, some studies reported positive results (Simmon & Tanaka, unpub.; CITI, 1980, unpub.; Simmon et al, 1977), while others were negative (NTP, 1983; Tardiff et al., 1976). Positive results have been reported in yeast cells (Chambers & Dutta, 1976; Gentile et al., 1982). Both positive results (Ahmed et al, 1979) and negative results (Tsushimoto et al. 1983) have been reported for chlordane inducing mutations in Chinese hamster V79 cells. New York concluded that sufficient "evidence exist to indicate that technical grade chlordane may be mutagenic in microbial and human cell cultures" (emphasis added) (NY DOH, 1984, pg.12)

4. CHLORDANE HAS PRODUCED REPRODUCTIVE EFFECTS

Chlordane has not been shown to be teratogenic but, passed through mothers' milk, it induced liver effects and death in a third generation of rat pups (Ingle, 1966). In rats, it has also altered endocrine parameters in offspring of exposed mothers (Cranmer et al. 1984). The authors of this later study encouraged "due caution in the exposure of the fetus to even low levels of organochlorine compounds" (Cranmer et al, 1984). Chlordane residues are persistent in fatty tissue, and they are known to be excreted in the milk of mothers who have been exposed to chlordane (Savage et al, 1981), thereby exposing infants to health risks.

5. OTHER STUDIES HAVE COME TO OUR ATTENTION SINCE OUR MEETING OF MAY 28, 1985. THEY CONFIRM OUR CONCERNS WITH CHLORDANE

In a 1983 article in the prestigious Journal of the National Cancer Institute, the mortality experience in licensed structural pesticide control applicators in Florida was examined (Blair et al, 1983). The authors found elevated mortality from lung cancer (SMR=135, p=0.052) in white males. They also found an increasing risk for lung cancer as the number of years licensed increased. It was not known what specific chemicals each individual was exposed to. Thus, it is impossible to link the excess risk of lung cancer to any specific chemical. It is known, however, that organochlorine chemicals, including chlordane, heptachlor, aldrin, dieldrin, DDT, etc., were the principal ones used in the 1950s and 1960s. In the late 1960s, there were gradually replaced by organophosphates and carbamates. Since most cancers have a latency period of 20-40 years after initial exposure to the carcinogenic agent, and since the study period here ended in 1977, exposures during the 1950s are of particular interest. The authors concluded "These findings, coupled with the tumorigenicity of some pesticides in laboratory

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animals and the potential for a widespread exposure among the general public, underscore the need for further research to clarify the carcinogenic risks of pesticides" (Blair et al, 1983).

In a 12 week feeding study, the activity of an enzyme (ATPase) was measured in rat brain tissue (Drummond et al., 1983). According to the authors, a deficiency in this enzyme could result in central nervous system dysfunction. Dose levels were 0, 25, 50, and 100 ppm in the diet. A decrease in the activity of the enzyme was seen in all groups except the control group, meaning a no-observed-effect-level was not seen. This is yet another effect of chlordane that has not been previously reported.

6. HEALTH EFFECTS HAVE BEEN REPORTED IN HOMES AFTER TERMITE TREATMENTS

In the Subcommittee deliberations on February 23, 1983, homeowners testified of health effects suffered after termite treatments with chlordane in their homes. Residents in Monterey and Newton complained of headaches and nausea while in their homes. In a recent case investigated by the Department of Food and Agriculture, a non-certified individual applied chlordane inside an apartment. The tenants inside the apartment reported their child experienced headaches and dizziness. Chlordane concentrations of 5.2 ug/m3 were found in the apartment.

Similar reports exist in other states. To cite a few:

- North Carolina reported that they have received similar health complaints in cases they have investigated. In the last year, they had 30-35 requests for indoor sampling. The majority of the samples were greater than 5 ug/m3, with the highest reading around 20 ug/m3 (personal communication, Bill Williams, NC Department of Health).

- West Virginia reported on health symptoms that may have been connected with chlordane exposure after termite treatments (West Virginia Department of Health, 1984). Common complaints included headaches, nausea, sore throat, and respiratory problems.

- In a court case in Los Angeles, chlordane was sprayed under and all around a house. The occupants experienced headaches, nausea, and stiffness. Levels of chlordane in the living area of the home ranged from 3.5 to 8.3 ug/m3.

7. MISAPPLICATIONS CONTINUE TO OCCUR IN MASSACHUSETTS SINCE THE IMPLEMENTATION OF THE REGULATIONS

Since the implementation of the regulations two years ago, the Department of Food and Agriculture (DFA) has received 15 complaints regarding chlordane use.

- Two of the cases involved landlords using the chemicals in buildings occupied by tenants. In one of these cases, the landlord wrote in an affidavit that a pesticide applicator recommended that he use chlordane in his building to control roaches.

- Two cases involved violations on the part of pesticide applicators. In one case, the certified applicator used a chlordane product that was not registered and used it to control carpenter ants. In the other case, the application was done by a non-certified commercial applicator. Some chlordane spilled into the family room of the house due to the fact that holes were not drilled deep enough to get through the concrete slab.

- Four cases are still pending. Of these four, it is not known exactly what pesticide was used in two cases. In the two cases involving chlordane, one case involved an alleged spill into a tool room located under concrete stairs through which the applicator had drilled. The applicator did not know a room was below the stairs. One case involves the alleged failure of the applicator to properly plug holes after the application was done.

- One case was reported to DFA on May 30, 1985, and is being investigated.

- Two cases involved applications done before the new regulations went into effect.

- Three cases involved no violation.

8. THE REGULATIONS ARE INADEQUATE TO PROTECT THE HOMEOWNER AGAINST CHLORDANE EXPOSURE

Thus, some chlordane misapplications continue to occur despite the new regulations. New York's Department of Conservation (DEC) said that there is probably much underreporting of such incidents (NY DEC affidavit, 1985). This will continue to be a problem, regardless of how strict the regulations might be.

At the Subcommitte hearings on February 23, 1983, where the issue of the revocation of chlordane was discussed, it was clearly expressed that monitoring data should be generated to determine whether the new regulations would be effective at preventing or minimizing exposure. Since then, however, no steps had been taken to do the monitoring in Massachusetts until the current Subcommittee review of chlordane. Thus, a request made by the Subcommittee, which it considered to be an important indicator of exposure under the new regulations, has not yet been conducted.

9. CHLORDANE IS VERY PERSISTENT

The persistence of chlordane in the environment is a major problem when contamination occurs. As noted two years ago, the Air Force had spent upwards of $800,000 to address some of their problems in base housing units contaminated with chlordane. Some Massachusetts homeowners have gone through considerable expense to lower levels in their homes. Furthermore, New York's Commissioner of Health stated in an August 27, 1984 letter "Extensive data on

surface contamination with the cyclodiene pesticides have demonstrated the difficulty in removing these materials from sites of application where there has been improper use".

EPA's Region II office issued an "Environmental Facts" sheet on termiticides in 1983. They stated "The National Pest Control Association which represents many structural pest control firms, has recommended for some time that slab and plenum houses not be treated except with chlorpyrifos, since the chlorinated hydrocarbons such as aldrin and chlordane cannot be decontaminated from a treated surface".

10. THERE IS AN ALTERNATIVE TO CHLORDANE

Chlorpyrifos has been registered for use in termite control since 1981. This compound has been the primary substitute for the uses for which chlordane has been cancelled (i.e., pests in cornfields, homes, gardens, carpenter ants, etc). Some uses of chlorpyrifos are permitted indoors while chlordane is not. When EPA cancelled all uses of chlordane except termite control, its reason for continuing the registration of chlordane for this use was that there was not a registered substitute which provided a better alternative. This is no longer the case. Further, the notice of intent to cancel (EPA, November 18, 1974) stated that the excepted use of subsurface ground insertion for termite control "achieves the desired control of insects without apparent unreasonable environmental contamination."

In 1983, we reported the results of an on-going test in Mississippi on the effectiveness of chlorpyrifos in termite control. Another call to Mr. Raymond Beal of the U.S. Department of Agriculture revealed chlorpyrifos is still 100% effective in the Mississippi site, bringing the number of years of effectiveness up to 17 years. In Maryland, the test site most similar to conditions encountered in Massachusetts, it continues to be 100% effective, now up to 13 years. Mr. Beal still feels chlorpyrifos will work well as a termiticide.

Chlorpyrifos ia a more expensive chemical than chlordane. The cost of the chemical is, however, a relatively small part of the total cost of a termite treatment. The NY DEC stated "The increased chemical cost represent approximately 10-15% of the overall cost of a typical residential application" (NY DEC affidavit, 1985, pg.7). Two years ago, Dow Chemical Company provided an example of cost comparisons in a typical treatment.

	chlordane	chlorpyrifos
Chemical Cost for treating home	$30[a]	$130
Assumed Application Costs	$400	$400
TOTAL COST	$430	$530

[a] Dow used a $35 figure, but EPA said a typical cost was $30 (EPA, 1983, pg.III-16)

Thus, while the chlorpyrifos itself costs over four times that of chlordane, the total application cost is only 23% higher.

Some have contended that since chlorpyrifos is not as effective as chlordane, more treatments are required and thus, the cost differential becomes greater. First, it is not known precisely how effective chlorpyrifos will be in Massachusetts, since the on-going test in Maryland is still 100% effective. Secondly, as EPA noted, "...current practices in the field indicate that treatments with the cyclodienes occurs more frequently than the 30+ years of termite control shown by these chemicals. If, in practice, the consumer is not able to take advantage of the extended period of protection, then the benefits of the cyclodienes would diminish" (EPA, pg, III-18).

The primary adverse health effect of chlorpyrifos is simple cholinesterase inhibition similar to other products of the organophosphate family. This effect can be meararured by determining total cholinesterase level in blood. Unlike the chlorinated cyclodienes, the mechanism of toxicity is clearly understood and medical treatment is straight forward. Also unlike chlordane, it is not as persistent in the body. The availability of chlorpyrifos as an alternative to the cyclodienes was a factor in the recommendation of the New York Department of Health to place an emergency ban on the cyclodienes (New York Department of Health, February 20, 1985 letter).

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